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FISH POPULATION STUDIES LEWIS AND CLARK LAKE MISSOURI RIVER, 1956 to 1962

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UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

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By
Charles H. Walburg

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FISH POPULATION STUDIES, LEWIS AND CLARK LAKE, MISSOURI RIVER, 1956-62

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ABSTRACT

Studies on 33,000-acre Lewis and Clark Lake, a mainstem Missouri River reservoir, during the first 7 years of impoundment (1956-62) indicate that carp, river carpsucker, and white crappie were the most abundant fishes. Other major species (listed phylogenetically) were shovelnose sturgeon, shortnose gar, smallmouth buffalo, channel catfish, black crappie, sauger, and freshwater drum. Relative abundance estimates, based on experimental gill net, frame net, and shore seine catches in the months of June, July, and August by South Dakota Department of Game, Fish, and Parks personnel in years 1956 through 1961, and by Bureau of Sport Fisheries and Wildlife personnel in 1962, suggest that total numbers of most species have declined since 1956. Fish reproduction and growth rates have also declined during the same period. Young-of-the-year gizzard shad were the dominant forage fish. The silvery minnow, abundant following impoundment, was replaced by the emerald shiner.

Lewis and Clark Lake was formed by the closure of Gavins Point Dam in July 1955. This reservoir, located on the Missouri River in southeastern South Dakota, forms a part of the boundary between the States of South Dakota and Nebraska. It is the smallest and southernmost of six mainstem reservoirs constructed by the U.S. Army Corps of Engineers in a comprehensive plan for flood control and other purposes in the Missouri River Basin.

Studies on the fish population of this reservoir were initiated in 1956 by the South Dakota Department of Game, Fish and Parks, and continued each year through 1961 as part of the Dingell-Johnson Federal aid to fish restoration program (projects F-1-R-6 through 11). The objective of these studies was to document the development of the fish population and suggest possible management techniques 1/.

In 1962 the North Central Reservoir Investigations, Bureau of Sport Fisheries and Wildlife, began studies on Lewis and Clark Lake. The objective of this investigation is to relate long-term water management operations of the Missouri River reservoirs to their fish populations. This will be accomplished by comprehensive fishery and limnological studies. With this information it should be possible to predict how different types of water management will influence a fish population so that reservoirs can be operated for greater benefit to sport fishing. Initial studies are being conducted on Lewis and Clark Lake, but future work will include other Missouri River Basin reservoirs.

This paper summarizes the results of studies conducted in Lewis and Clark Lake since formation of the reservoir and follows the development of the fish population through

1/Shields, James T. 1957. Report of fisheries investigations during the second year of impoundment of Gavins Point Reservoir, S. Dak., 1956. Dingell-Johnson Project F-1-R-6, 34 pp. (Mimeo.)

1962. Information on fishes collected from 1956 to 1961 was obtained from Dingell-Johnson Project Reports prepared by the South Dakota Department of Game, Fish and Parks (see appendix A). The 1962 data were collected by the staff of the North Central Reservoir Investigations.

LEWIS AND CLARK LAKE

Lewis and Clark Lake has the following characteristics: Maximum surface area, 33,000 acres; length, 37 miles; average width, 2 miles; maximum depth, 45 feet; average depth, 16 feet; shoreline length, 100 miles; and storage capacity, 540,000 acre-feet. It is a re-regulatory reservoir, controlling water releases from Fort Randall Dam (78 miles upstream) to provide downstream navigation, power generation, and flood control. The lake level is maintained between 1,204 and 1,208 feet m.s.l. under normal operational conditions. Weekly fluctuations in water level do not normally exceed 2 feet.

The downstream one-third of the reservoir is bounded by steeply sloped banks, and the entire river flood plain is inundated. The downstream two-thirds of the reservoir area was cleared of brush and trees prior to flooding. The upstream portion has a number of clusters of inundated timber. The shoreline is essentially straight except for a few narrow bays at the mouths of small tributary streams. The lake bottom is largely mud and silt with a few isolated areas of sand and gravel. Six small intermittent streams enter the reservoir (fig. 1). The Niobrara River, with a mean daily flow of 1,750 c.f.s., enters the Missouri River about 3 miles above the reservoir. The Niobrara River carries a considerable silt load and is responsible for much silt deposition in the upper reservoir. This condition has a marked influence on the turbidity and hence the biota of Lewis and Clark Lake.

The reservoir is characterized by a rapid exchange of water. During the navigation season (March through November) its entire storage capacity is passed through the dam every 8 to 10 days. During the winter months complete water exchange is possible every 30 days. The high rate of water exchange is thought to have a profound effect on the physical, chemical, and biological conditions found in these waters. The lake has no permanent thermocline during the summer months. Water temperature is strongly influenced by wind and rarely exceeds 82° F. Dissolved oxygen concentrations during summer months range from 4.9 to 9.0 p.p.m. Alkalinity ranges from 140 to 177 p.p.m. and pH from 7.8 to 8.2. Secchi disk visibility ranges from 3 inches in the extreme upper reservoir to 3 feet near the dam. Turbidity is influenced both by the Niobrara River and by wave action stirring up the lake bottom and eroding banks.

FISH SAMPLING

South Dakota Department of Game, Fish and Parks studies in Lewis and Clark Lake were designed to furnish information concerning (1) relative species composition, (2) area and depth distribution, (3) age and growth of scaled fishes, (4) reproduction success and period of spawning, (5) age at maturity, and (6) length-weight distribution. (Shields, 1957, op. cit.) Study areas were established about 3 and 11 miles upstream from the dam, and in each area nets were fished in a 3-to 4-mile section of the reservoir. Stations were sampled three times during the summer (June, July and August) and the sampling period occupied 4 days, or 3 overnight net sets. Standard netting equipment included three frame or modified fyke nets with 75-foot leads (mesh size, 2.0 inch as stretch measure), two 250-foot nylon experimental gill nets (mesh sizes, 1.5, 2.0, 2.5, 3.0, and 4.0 inches stretch measure), and a 40-foot, 1/4-inch-mesh, bag seine. Effort was made to fish all depths and all habitats. Gill and frame nets were fished at least 16 hours with each net set before 4 p.m. and lifted after 8 a.m. the following day. All sets were considered comparable "24-hour" sets.

Total length, weight, sex, and maturity were recorded for as many as 100 fish of each species during each netting period by South Dakota fishery biologists. Scale samples were obtained from not more than 25 of each scaled species during each netting period and were selected to represent all size groups. From 10 to 20 seine hauls were made during one day of each netting period, and all shoreline habitats were sampled. Number of hauls was dependent on shoreline conditions and number and species of fish caught. Sampling

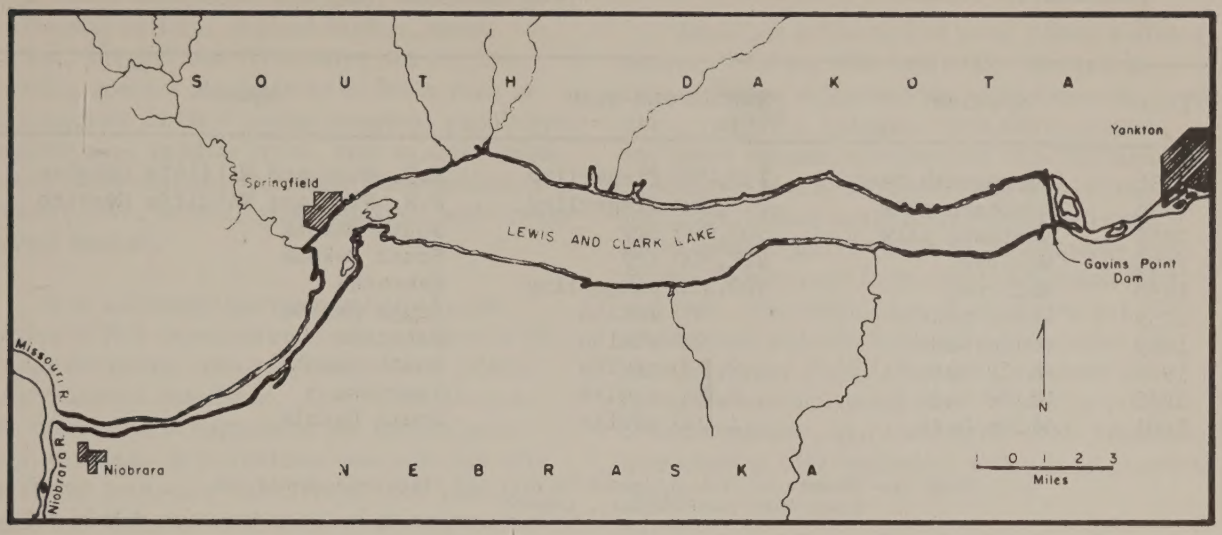

Figure 1:--Lewis and Clark Lake, a mainstem Missouri River reservoir.

methods remained essentially the same through 1961. Beginning in 1959 another study area, 18 miles above the dam, was added to investigate the upper reaches of the reservoir.

Methods used by the Bureau of Sport Fisheries and Wildlife to sample the reservoir in 1962 were similar to those employed by South Dakota. Six study areas were established, extending from the dam to the mouth of the Niobrara River, and each area was sampled eight times from May through October. Sampling equipment included two frame or modified fyke nets with 75-foot leads (mesh size, 2 1/2 inches stretch measure), two 250-foot nylon gill nets (one with mesh sizes 0.5, 1.5, 2.5, 4.0, and 6.0 inches stretch measure, and the other with mesh sizes 1.0, 2.0, 3.0, 5.0, and 7.0 inches stretch measure), a 40-foot, 1/4-inch-mesh, bag seine, a 220-volt boom electroshocker boat, and a 16-foot semiballoon trawl. Data collected with the two latter types of sampling gear and the gill net mesh sizes not fished in former years were not used for comparison with previous years' studies.

A scale sample, total length, weight, sex, and maturity were obtained from as many as 25 fish of each species collected at each station by each gear. Length frequency was recorded for as many as 100 fish of each species collected at each station. Scale samples were selected to include all size groups, and fish used for length frequency were selected at random. Shore seining was completed in a manner similar to that of previous years. Common and scientific names of fishes collected are listed in appendix B. Nomenclature follows that of Bailey et al. (1960).

RELATIVE ABUNDANCE

The fish species found in Lewis and Clark Lake were those which occurred in this section of the Missouri River before closure of Gavins Point Dam. By mutual agreement among Nebraska, South Dakota, and the Bureau of Sport Fisheries and Wildlife, fish stocking in the reservoir was limited to four species (table 1). Numbers of fish captured by gill and frame nets in June, July, and August, 1956 through 1962, were used to determine trends in abundance of those species vulnerable to these gears (table 2). Thirty-three species, exclusive of minnows, were collected from the reservoir during these years, but only 23 were taken in 1962. Most abundant fishes were

Table 1:--Numbers of fish stocked, Lewis and Clark Lake, 1956-62
(Information obtained from South Dakota Dingell-Johnson Project Reports appendix A)

Year	Species	Number and size	Agency
1956	Largemouth bass	150,000 fingerling	U.S. Fish and Wildlife Service
1958	Northern pike	211,680 fingerling	U.S. Fish and Wildlife Service
1958	Northern pike	500,000 fry	South Dakota
1958	Walleye	411,900 fry	South Dakota
1958	Walleye	500,426 fingerling	Nebraska
1959	White bass	800 adults	South Dakota
1959	White bass	300 adults	Nebraska
1960	White bass	2,370 adults	South Dakota
1960	White bass	2,000 adults	Nebraska
1961	White bass	1,000 adults	South Dakota

Table 2:-- Numbers of fish collected by gill and frame nets, Lewis and Clark Lake (June-August), 1956-62

Species	1956	1957	1958	1959	1960	1961	1962
Pallid sturgeon	- -	9	3	2	- -	3	- -
Shovelnose sturgeon	332	393	57	127	22	59	85
Paddlefish	- -	1	- -	- -	1	2	- -
Shortnose gar	139	172	178	154	138	170	56
Longnose gar	- -	- -	- -	1	- -	- -	- -
Gizzard shad	54	233	27	147	21	11	18
Rainbow trout 1/	- -	- -	1	- -	- -	- -	- -
Goldeye	93	64	34	4	24	21	41
Northern pike	- -	1	- -	2	- -	- -	3
Carp	7,091	4,609	1,765	1,416	718	869	957
River carpsucker	890	882	861	634	442	540	688
Smallmouth buffalo	12	138	160	124	95	58	87
Bigmouth buffalo	68	82	93	92	20	33	33
Blue sucker	6	12	7	5	- -	5	1
White sucker	2	2	3	- -	- -	- -	- -
Northern redhorse	26	70	126	72	27	56	75
Black bullhead	52	68	16	3	1	- -	1
Channel catfish	460	282	220	219	151	193	211
Flathead catfish	7	16	4	14	3	10	12
Blue catfish	11	4	- -	- -	- -	- -	- -
Stonecat	2	1	- -	- -	- -	- -	- -
Burbot	3	2	2	- -	- -	- -	- -
White bass	- -	- -	- -	- -	- -	- -	22
Green sunfish	3	22	2	1	3	1	- -
Bluegill	12	51	152	93	66	69	10
Orangespotted sunfish	- -	1	- -	- -	- -	- -	- -
Hybrid sunfish	2	- -	4	- -	- -	- -	- -
Largemouth bass	9	16	19	15	17	11	4
White crappie	240	521	2,835	1,723	228	642	394
Black crappie	144	4,694	2,555	896	87	63	51
Yellow perch	66	9	16	4	3	5	4
Sauger	25	67	103	149	111	90	93
Walleye	- -	11	12	- -	2	2	13
Freshwater drum	71	36	56	41	31	48	231
Total	9,820	12,469	9,311	5,938	2,211	2,961	3,090

1/ Species stocked in Fort Randall Tailwaters, 1956 and 1957.

carp, river carpsucker, and white crappie. The remaining major species, not in order of abundance, were shovelnose sturgeon, shortnose gar, smallmouth buffalo, channel catfish, black crappie, sauger, and freshwater drum. The following species disappeared or were rare in the reservoir in 1962: pallid sturgeon, paddlefish, longnose gar, rainbow trout, blue sucker, white sucker, blue catfish, stonecat, black bullhead, northern pike, burbot, green sunfish, and orange-spotted sunfish.

It is assumed that the number of each species of fish captured each year, based on the amount of fishing effort expended, was related to their actual abundance. Only those sizes of fish vulnerable to capture by the fishing gear were included. It is realized that both gill nets and frame nets were selective to both size and species of fish captured and that abundance estimates derived from their use must be viewed with caution. Validity of the method used to estimate relative species abundance is dependent upon similar fish behavior within and between years. Behavior is influenced by changes in the reservoir environment such as water level fluctuation, turbidity, wind, and available food. Despite these limitations, and because the annual catch data were obtained in a reasonably consistant manner, they constitute a useful index of species abundance.

Frame nets and gill nets were not equally efficient in fish capture (tables 3 and 4) and it was necessary to adjust the fishing effort of these gears to a standard unit. Relative annual abundance of each species was determined by comparison of the average catch per unit of effort of each type of fishing gear. From this comparison, the relative efficiency of the frame net to the gill net in the capture of the various species was determined. The number of gill net sets was multiplied by an efficiency factor to obtain total effort in frame net units (adjusted effort). Total catch was divided by adjusted effort to obtain the adjusted catch per unit of effort in each year. Adjusted catch per unit of effort in each year was compared with that in 1956, and relative abundance in relation to 1956 was determined. This procedure was followed to determine the relative annual abundance of each major species, and is illustrated for the river carpsucker in table 5.

Apparent abundance of most fishes declined between 1956 and 1962 (table 6). Marked decreases were suggested for shovelnose sturgeon, carp, and black crappie. Both white crappie and black crappie experienced wide fluctuations in abundance and in 1962 were at a relatively low level. Black crappie predominated over white crappie in 1957 but this relationship was gradually reversed in the period between 1958 and 1962. The abundance of shortnose gar, smallmouth buffalo, and river carpsucker remained rather stable after 1957. Sauger abundance has increased since the early years of impoundment, and freshwater drum abundance increased in 1962 compared with that of previous years.

Shoreline seining was conducted to determine the relative abundance of fishes vulnerable to capture by this gear (table 7). The silvery minnow, which was most abundant following formation of the reservoir, declined to a low level and the emerald shiner became the dominant cyprinid species. Gizzard shad, relatively rare prior to impoundment, became the most abundant forage species. Similar changes in shad abundance were noted by Martin and Campbell (1953) in Clearwater Lake.

LIFE-HISTORY OBSERVATIONS

General life-history studies were conducted on fishes collected, to determine (1) age and rate of growth, (2) age-class composition, (3) habitat preference, (4) period of spawning, and (5) reproduction success. All fish lengths reported are total lengths in inches. Scaled fishes were aged by conventional methods (Lagler, 1952). Aging of nonscaled fish, which was begun in 1962, was from study of spine or fin ray cross-sections and branchiostegals. Average calculated lengths at each annulus were determined by assuming a straight-line relation. Habitat preference was determined from location of fish capture within the reservoir. Period of spawning was determined from gross observation of gonads. Shoreline seining (table 7) was used to indicate reproductive success.

Table 3:--Number of major fish species taken by frame net and number of frame net sets, Lewis and Clark Lake, 1956-62

Species	1956	1957	1958	1959	1960	1961	1962
Shovelnose sturgeon	- -	- -	- -	- -	- -	- -	- -
Shortnose gar	106	125	136	116	98	126	32
Carp	6,415	3,478	705	335	112	242	506
River carpsucker	832	660	437	250	105	165	549
Smallmouth buffalo	5	109	64	28	11	16	60
Channel catfish	184	18	15	7	2	1	7
White crappie	224	441	2,330	1,583	147	581	352
Black crappie	143	4,624	2,546	891	86	60	48
Sauger	5	17	51	38	11	26	41
Freshwater drum	54	11	26	10	5	8	68
Frame net sets	51	44	50	48	30	33	56

Table 4:-- Number of major fish species taken by gill net and number of gill net sets, Lewis and Clark Lake, 1956-62

Species	1956	1957	1958	1959	1960	1961	1962
Shovelnose sturgeon	332	393	57	127	22	59	85
Shortnose gar	33	47	42	38	40	44	24
Carp	676	1,135	1,060	1,081	606	627	451
River carpsucker	58	222	424	384	337	375	139
Smallmouth buffalo	7	29	96	96	84	42	27
Channel catfish	276	264	205	212	149	192	204
White crappie	16	80	505	140	81	61	42
Black crappie	1	70	9	5	1	3	3
Sauger	20	50	52	111	100	64	52
Freshwater drum	17	25	30	31	26	40	163
Gill net sets	32	39	51	54	33	36	27

Table 5:--Method used to determine relative abundance of river carpsucker, Lewis and Clark Lake, 1956-62

Year	Frame net			Gill net		
	Effort (sets)	Catch (numbers)	Catch/ effort	Effort (sets)	Catch (numbers)	Catch/ effort
1956	51	832	16.3	32	58	1.8
1957	44	660	15.0	39	222	5.7
1958	50	437	8.7	51	424	8.3
1959	48	250	5.2	54	384	7.1
1960	30	105	3.5	33	337	10.2
1961	33	165	5.0	36	375	10.4
1962	56	549	9.8	27	139	5.1
Average catch/effort			9.1			6.9
Relative efficiency			1.00			0.76

Year	Effort (sets)			Catch (numbers)	Adjusted catch/ effort	Relative abundance
	Frame net	Gill net X 0.76	Adjusted			
1956	51	24	75	890	11.9	1.0
1957	44	30	74	882	11.9	1.0
1958	50	39	89	861	9.7	.8
1959	48	41	89	634	7.1	.6
1960	30	25	55	442	8.0	.7
1961	33	27	60	540	9.0	.8
1962	56	20	76	688	9.0	.8

Table 6:--Relative abundance of major fish species compared to 1956, Lewis and Clark Lake, 1956-62

Species	1956	1957	1958	1959	1960	1961	1962
Shovelnose sturgeon	1.0	1.0	0.1	0.2	0.1	0.2	0.3
Shortnose gar	1.0	1.3	1.1	1.0	1.4	1.6	0.4
Carp	1.0	0.7	0.2	0.2	0.1	0.2	0.1
River carpsucker	1.0	1.0	0.8	0.6	0.7	0.8	0.8
Smallmouth buffalo	1.0	14.0	13.0	10.0	12.0	7.0	9.0
Channel catfish	1.0	0.5	0.3	0.3	0.3	0.4	0.5
White crappie	1.0	2.4	11.2	7.1	1.5	3.8	1.5
Black crappie	1.0	38.1	18.2	6.7	1.0	0.7	0.3
Sauger	1.0	2.4	2.9	4.2	5.1	3.7	3.9
Freshwater drum	1.0	0.5	0.6	0.4	0.5	0.7	3.5

Table 7:-- Average number of fish collected per acre by shoreline seining, Lewis and Clark Lake, 1956-62

Species	1956	1957	1958	1959	1960	1961	1962
Shortnose gar	2	- -	- -	- -	- -	- -	- -
Gizzard shad	29	142	48	310	269	166	238
Carp	429	- -	- -	1	1	27	6
Silvery minnow	405	33	- -	- -	8	1	+
Flathead chub	- -	1	- -	- -	5	- -	1
Silver chub	- -	1	- -	- -	- -	- -	- -
Emerald shiner	7	13	- -	205	248	75	190
Red shiner	10	14	- -	3	7	33	8
Sand shiner	1	3	- -	- -	- -	- -	- -
Fathead minnow	5	- -	- -	- -	2	- -	3
Unidentified minnows	- -	26	69	- -	- -	- -	- -
River carpsucker	126	6	1	9	43	56	11
Smallmouth buffalo	36	1	- -	- -	- -	- -	- -
Bigmouth buffalo	20	- -	- -	- -	1	+	1
Northern redhorse	7	- -	- -	- -	- -	- -	- -
Black bullhead	1	- -	- -	- -	- -	- -	- -
Channel catfish	+	+	- -	+	- -	+	1
White bass	- -	- -	- -	- -	+	1	16
Green sunfish	+	- -	- -	- -	- -	- -	- -
Bluegill	3	1	- -	2	+	- -	+
Orangespotted sunfish	+	- -	- -	- -	- -	- -	+
Largemouth bass	14	- -	2	1	1	- -	2
White crappie	43	2	2	1	- -	- -	12
Black crappie	42	+	2	+	+	- -	1
Yellow perch	20	10	17	- -	3	- -	1
Sauger	3	1	1	2	3	2	2
Freshwater drum	- -	- -	+	- -	+	- -	3
Total	1,203	254	142	534	591	361	496
Acres seined	4.55	2.97	2.32	3.96	4.49	2.73	9.32

+Less than 0.5 fish per acre seined

These latter results must be viewed with caution because (1) suitable seining areas were uncommon and much sampling was conducted over mud bottom, (2) species were not equally available to capture because of difference in habitat preference, and (3) fish behavior and hence availability was influenced by water level fluctuation. Some life-history information on the fishes collected in these studies is summarized below. Minnow species were not included.

Pallid sturgeon

Only 17 pallid sturgeon were captured during the 7 years of study, and none was captured in 1962. Fish lengths ranged from 26 to 51 inches, excluding caudal filament, and weights from 3.5 to 18.8 pounds. This species was comparatively rare in the reservoir but of interest because of its large size. One fish captured in the Missouri River in North Dakota weighed in excess of 68 pounds (Bailey and Allum, 1962).

Shovelnose sturgeon

This species was common in Lewis and Clark Lake but most abundant in the river channel of the upper reservoir. Lenghts of fish captured ranged from 13.0 to 31.0 inches, excluding caudal filament. Most fish were between 16.0 and 22.0 inches long and average weight was approximately 0.6 pounds. Sexes were about equally represented in the catch. Spawning was completed by late June but no young-of-the-year were collected. Abundance of this species declined after formation of the reservoir (table 6) and since shovelnose sturgeon

prefer a river-type habitat (Bailey and Cross, 1954), their decline will probably continue.

Paddlefish

Only four paddlefish were collected during the 7 years of study. Weight of these fish ranged from 17.5 to 38.0 pounds. This catch was not indicative of the abundance of this species, since it is seldom taken by frame net or small-mesh gill nets. Paddlefish were taken each year by sport fishermen in the tailwaters of Fort Randall Dam, and individuals were observed surfacing in Lewis and Clark Lake. Young-of-the-year were not collected with the fishing gears reported in this study; however, in 1962 a total of six, ranging in length from 5.9 to 10.8 inches, were taken in August and October by bottom trawl in the old river channel in the central section of the reservoir. Capture of these juveniles indicates that this species was able to reproduce in the reservoir or in the Missouri River below Fort Randall Dam.

Shortnose gar

This species was common in the reservoir, and most were collected from the relatively shallow water of the old river flood plain. Fish lengths ranged from 12.0 to 30.3 inches. In 1962, lengths of females averaged 24.5 inches and weight 1.8 pounds, while length of males averaged 22.5 inches and weight 1.4 pounds. All fish over 20.0 inches in length were mature, and spawning occurred during the last 2 weeks in June. Young-of-the-year were taken only in 1956 (table 7). Abundance and length distribution of gar collected each year suggests adequate reproduction to maintain the population at a rather stable level (table 6). Most abundant year-classes were produced in 1958 and 1959, and growth rate after the first year (table 8) was similar to that reported by Netsch and Witt (1962) for the longnose gar in Missouri. This species appears well adapted to conditions in the reservoir.

Longnose gar

Only one longnose gar was collected in the reservoir, although this species was observed in the dam tailwaters. Gavins Point Dam may be the upstream limit of this species in the Missouri River, since none was collected by South Dakota biologists in their studies on the fish populations in Fort Randall and Oahe Reservoirs.

Gizzard shad

There was a relatively small adult population of gizzard shad in Lewis and Clark Lake. According to Bailey and Allum (1962), southeastern South Dakota is on the northern edge of the range of this species. Spawning usually occurred during the last 2 weeks of June, and since this species has a high reproductive potential, young-of-the-year were typically abundant (table 7).

Survival of juneniles to their second summer was very erratic because of winter mortality. Reservoir water temperatures were not available for the period 1956-62 for comparison with juvenile shad survival. However, number of days of ice cover in each of the seven winters since impoundment was estimated from known meteorological information in winters 1959-60 through 1962-63. Estimated number of days of reservoir ice cover for each winter, 1956-57 through 1962-63, was as follows:

1956-57	101 days
1957-58	88 days
1958-59	107 days
1959-60	117 days
1960-61	103 days
1961-62	129 days
1962-63	103 days

There was no apparent over-winter survival of young-of-the-year shad when reservoir ice cover exceeded 103 days. Survival of shad to age group I was attained in 1957, 1958, and 1961 (table 9). Preliminary analysis of 1963 collections indicates good survival of the 1962 year-class to their second summer.

Survival of the 1956 and 1957 year-classes was good, but year-class survival after that timewas poor (table 9). All fish were sexually mature at age group III. Young- of-the-year shad was the dominant forage fish in Lewis and Clark Lake.

Table 8:-- Age-class distribution and average total length at each annulus for 259 shortnose gar collected in June, Lewis and Clark Lake, 1962

Age group	Year class	Age distribution (percent)	Average length (inches)
I	1961	12	16.4
II	1960	12	19.1
III	1959	23	21.1
IV	1958	36	23.1
V	1957	10	23.8
VI	1956	6	26.4
VII	1955	1	28.9

Table 9:-- Age-class distribution of gizzard shad, in percent of sample aged, Lewis and Clark Lake, 1956-62

	Year of collection						
Age group	1956	1957	1958	1959	1960	1961	1962
I	- -	100	14	- -	- -	38	- -
II	- -	- -	86	31	- -	- -	- -
III	- -	- -	- -	69	25	- -	- -
IV	- -	- -	- -	- -	70	38	- -
V	- -	- -	- -	- -	5	24	58
VI	- -	- -	- -	- -	- -	- -	42
No. fish aged	0[1/]	35	21	77	20	8	12

1/ All fish young-of-the-year

Rainbow trout

One rainbow trout was collected from the reservoir in 1958 (table 2). This species was stocked in the tailwaters of Fort Randall Dam in 1956 and 1957. The experiment was apparently not successful because of unsatisfactory environmental conditions.

Goldeye

Goldeye was a minor species in the reservoir and its abundance decreased between 1956 and 1962 (table 2). The catch was dominated by the 1955, 1956, and 1957 year-classes (table 10). Spawning usually occurred during the last two weeks of June. No young-of-the-year were collected after 1957. Growth of this species, as determined from average length at various ages, was comparable to that found in other areas of the United States (Carlander, 1953).

Carp

Carp were generally distributed throughout the reservoir and were the most abundant fish collected in Lewis and Clark Lake. This abundance was attributed to strong 1955 and 1956 year-classes and these fish dominated the catch through 1962 (table 11). Carp reproduction after 1957 was relatively poor (table 7), and relative abundance of this species declined through 1962 (table 6).

Spawning occurred during June and annulus formation in most fish was completed by July 1. Average length in inches by age group for fish through 9 years of age collected in 1962 was as follows: I, 3.3; II, 5.6; III, 6.7; IV, 8.3; V, 9.2; VI, 10.5; VII, 12.1: VIII, 14.6; and IX, 15.8. Average length of age group VI carp taken in Oahe Reservoir in 1959 was 19.5 inches, 2/and length of age group IV carp taken in Fort Randall Reservoir in 1959 was 15.7 inches 3/ Growth of carp in Lewis and Clark Lake was poor compared with that obtained in other mainstem Missouri River reservoirs and with that found in other areas of the United States (Carlander, 1953).

River carpsucker

This species was well distributed throughout the reservoir and ranked second to carp in the catch (table 2). Carpsucker abundance remained relatively constant between 1956 and 1962 (table 6), and the population was largely dominated by the 1955 and 1956 year-classes. In 1962 the 1955 year-class declined, and the 1957 year-class became important (table 12). Shore seining indicated that reproductive success was good in 1960 and 1961 (table 7).

The carpsucker usually spawned during the last 2 weeks of June and annulus formation was completed by July 1. Average length in inches by age group for fish collected in 1962 was as follows: I, 2.2; II, 4.6; III, 7.0; IV, 8.5; V, 10.2; VI, 11.5; and VII, 13.6. Growth was poor compared with other mainstem Missouri River reservoirs. Average total length of age group VI carpsucker in Oahe Reservoir was 14.7 inches 2/ and in Fort Randall Reservoir 17.2 inches 3/. This species is apparently well adapted to the reservoir, since reproduction was successful in most years and its relative abundance remained unchanged.

Smallmouth buffalo

There was a small population of smallmouth buffalo in the reservoir, and its abundance remained relatively stable between 1957 and 1962 (table 6). Spawning was usually completed by the end of June. A large year-class was produced in 1956, the year following dam closure, and this group almost exclusively dominated the population through 1962 (table 13). Shore seining suggests poor reproduction each year since 1956 (table 7).

2/ Fogle, Ned E. 1961. Report of fisheries investigations during the second year of impoundment of Oahe Reservoir, S. Dak., 1959. Dingell-Johnson Project F-1-R-9, 43 pp. (Mimeo.)

3/ Sprague, James W. 1961. Report of fisheries investigations during the seventh year of impoundment of Fort Randall Reservoir, South Dakota, 1959. Dingell-Johnson Project F-1-R-9, 49 pp. (Mimeo.).

Table 10:-- Age-class distribution of goldeye, in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of collection						
	1956	1957	1958	1959	1960	1961	1962
I	1	- -	- -	- -	- -	- -	- -
II	11	9	3	- -	- -	- -	- -
III	58	45	25	- -	46	- -	- -
IV	23	30	34	25	26	50	2
V	5	13	22	75	9	28	24
VI	1	2	12	- -	9	14	44
VII	- -	- -	3	- -	- -	7	24
VIII	- -	- -	- -	- -	- -	- -	6
No. fish aged	81	53	32	4	24	14	41

Table 11:--Age-class distribution of carp, in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of collection						
	1956	1957	1958	1959	1960	1961	1962
I	63	34	1	- -	- -	- -	- -
II	5	57	46	1	- -	- -	1
III	18	2	43	42	5	2	- -
IV	7	4	7	45	59	16	10
V	5	1	- -	6	21	58	24
VI	1	1	- 2	2	8	17	32
VII	1	1	1	2	3	5	18
VIII	- -	- -	- -	- -	3	2	5
IX	- -	- -	- -	1	1	- -	4
IX plus	- -	- -	- -	1	- -	- -	6
Number of fish aged	223	155	143	167	145	103	642

Table 12:-- Age-class distribution of river carpsucker, in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of collection						
	1956	1957	1958	1959	1960	1961	1962
I	43	2	- -	- -	- -	- -	- -
II	15	75	1	- -	1	1	1
III	13	8	63	6	3	3	- -
IV	12	7	22	82	21	6	6
V	10	5	4	7	68	46	29
VI	6	2	6	3	5	43	61
VII	1	1	3	2	1	1	3
VIII	- -	- -	1	- -	1	- -	-
No. fish aged	205	153	140	151	143	139	348

Table 13:-- Age-class distribution of smallmouth buffalo in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of Collection						
	1956	1957	1958	1959	1960	1961	1962
I	- -	100	- -	- -	- -	- -	- -
II	- -	- -	96	- -	- -	- -	- -
III	11	- -	2	77	7	- -	- -
IV	24	- -	- -	11	92	4	3
V	45	- -	- -	3	- -	90	34
VI	11	- -	- -	1	- -	6	61
VII	11	- -	- -	4	1	- -	2
VIII	- -	- -	- -	3	- -	- -	- -
Number of fish aged	9	97	121	96	86	49	85

Average length in inches by age group for fish collected in 1962 was as follows: IV, 10.2; V, 11.8; VI, 13.0; and VII, 17.9. A marked difference in growth increment between 6-and 7-year-old fish and 5-and 6-year-old fish is apparent. The 7-year-old fish were produced before closure of the dam. Growth was slower than that recorded in other Missouri River reservoirs. Six-year-old smallmouth buffalo taken in Oahe Reservoir in 1959 averaged 19.9 inches in length, (Fogle, 1961, op. cit.) while 4-year-olds taken in Fort Randall Reservoir in 1959 were 15.8 inches long (Sprague, 1961, op. cit.). The poor reproduction and growth experienced by this species in Lewis and Clark Lake suggests that it has been unable to adapt to conditions found in the reservoir and that the population will remain small.

Bigmouth buffalo

There was a small population of bigmouth buffalo in the reservoir, dominated almost entirely by the 1956 year-class (table 14). Net collections indicated that abundance of this species declined after 1959 (table 2). Reproduction was good in 1956, and young were also collected between 1960 and 1962 (table 7). Average length in inches by age group for fish collected in 1962 was as follows: IV, 9.5; V, 14.1; VI, 16.4; and VII, 19.0. Growth of this species in Lewis and Clark Lake was poorer than in the other Missouri River reservoirs in South Dakota. Six-year-old fish taken from Oahe and Fort Randall Reservoirs in 1959 were 19.7 (Fogle, 1961, op. cit.) and 20.1 inches (Sprague, 1961, op. cit.) long, respectively. Bigmouth buffalo will probably remain of minor importance in this reservoir.

Blue sucker

This species was uncommon in the reservoir, and its abundance decreased after 1956 (table 2). Trautman (1957) suggests that the blue sucker prefers clear waters which may account for its rarity in Lewis and Clark Lake.

White sucker

Although this species is common throughout South Dakota, it is uncommon in the Missouri River (Bailey and Allum, 1962). The white sucker was rare in the reservoir and was collected only during the first 3 years of study.

Northern redhorse

The northern redhorse was a minor species in the reservoir, and its apparent abundance changed little between 1956 and 1962 (table 2). Spawning was usually completed by the third week of June. From the age-class distribution of the catch (table 15), it is apparent that some reproduction occurred each year, although young-of-the-year were collected only in 1956. Average length in inches by age group for fish collected in 1962 was as follows: I, 2.6; II, 6.8; III, 10.2; IV, 12.6; V, 13.7; and VI, 16.0. Growth was comparable to that found for this species in Minnesota (Kuehn, 1949), but less than reported in Oklahoma (Jenkins et al., 1952). The northern redhorse is apparently rather short-lived in Lewis and Clark Lake since most fish were less than 5 years old and none were over 6 years of age (table 15).

Black bullhead

There was a small population of black bullhead during the early years of impoundment, but after 1958 it became rare (table 2). The decline suggests that this species was unable to adapt to conditions in the reservoir. A similar history was experienced by this fish in Fort Randall Reservoir where it was common for several years after the reservoir was formed, but by 1959, the seventh year of impoundment, none was collected (Sprague, 1961, op. cit.).

Channel catfish

The channel catfish was one of the major fishes in the reservoir, but most were collected in 1956, the year following dam closure. Since 1957 its apparent abundance has been reduced to about one-half that of 1956 (table 6). It was generally distributed throughout the reservoir, but most fish were collected about midway up the lake in the old river channel.

Table 14:-- Age-class distribution of bigmouth buffalo in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of collection						
	1956	1957	1958	1959	1960	1961	1962
I	- -	94	- -	- -	- -	- -	- -
II	- -	2	96	3	- -	- -	- -
III	- -	4	1	90	32	- -	- -
IV	- -	- -	1	7	47	22	3
V	- -	- -	1	- -	10	68	12
VI	- -	- -	- -	- -	10	10	75
VII	- -	- -	- -	- -	- -	- -	9
Number of fish aged	0[1/]	57	69	60	19	31	32

1/ All fish young-of-the-year

Table 15:-- Age-class distribution of northern redhorse in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of collection						
	1956	1957	1958	1959	1960	1961	1962
I	88	13	- -	- -	- -	2	2
II	8	83	91	1	- -	4	26
III	- -	4	9	98	42	32	13
IV	4	- -	- -	1	58	53	21
V	- -	- -	- -	- -	- -	10	36
VI	- -	- -	- -	- -	- -	- -	2
Number of fish aged	25	51	103	65	26	51	63

Spawning was usually completed by June 15. Age-class distribution of fish collected in 1962 suggested that annual reproductive success was erratic (table 16). The 1956 year-class was most abundant, but good reproduction also occurred in 1955 and 1960. Reproductive success has apparently been weak in most years since impoundment. Comparison of the average length of comparable age fish collected from other areas of the U.S. indicates that growth of the channel catfish in this reservoir was poor (table 16). Average total length of 6-year-old fish collected in 23 Oklahoma reservoirs was 17.0 inches (Finnell and Jenkins, 1954), while in Lewis and Clark Lake they averaged only 12.9 inches.

Flathead catfish

This species was uncommon; few were collected during the 7-year study (table 2). Total length of fish taken in 1962 ranged from 9 to 30 inches, and weight ranged from 0.5 to 14 pounds. These data suggest a small but relatively stable population of this species.

Blue catfish

Blue catfish were collected only during the first 2 years of impoundment (table 2). Apparent disappearance of this fish suggests that it was unable to adapt to Lewis and Clark reservoir conditions. None was collected in Fort Randall Reservoir after 6 years of intensive netting (Bailey and Allum, 1962). Gavins Point Dam is probably the upstream limit for this species in the Missouri River.

Stonecat

Three were collected during the first 2 years after impoundment, and none was collected since 1958.

Northern pike

Only six northern pike were collected during the 7 years of study (table 2). There was no evidence of survival of the 711,680 fry and fingerlings stocked in 1958 (table 1). Early spring water level fluctuations at the time when pike usually spawn have probably been unfavorable for reproduction of this species. Studies conducted in 1962 indicate that this fish is common in the Missouri River between Fort Randall Dam and the Niobrara River and that few fish move into the reservoir.

Burbot

This species was collected only during the first 3 years after impoundment (table 2). Its disappearance suggests that ecological conditions within the reservoir have been unfavorable, since several specimens were collected from the tailwaters of Fort Randall Dam in 1962.

White bass

Between 1959 and 1961 the States of South Dakota and Nebraska introduced 6,470 adult white bass into the reservoir (table 1). This fish was not present in Lewis and Clark Lake prior to 1959. According to Sprague, 4/, the desirability of stocking white bass was thoroughly investigated and available information indicated that it had potential to adapt to conditions existing in the reservoir and could provide good sport fishing without serious detriment to other game species.

Young-of-the-year were collected by shore seine from 1960 to 1962, and most were taken in 1962 indicating that successful reproduction had occurred (table 7). Adults were first taken in 1962 (table 2), and most were collected in the lower portion of the reservoir. Spawning occurred prior to the middle of June. Most 2-year-old fish were mature. Lengths of age group I and age group II fish were 5.4 and 11.4 inches, respectively. Available evidence suggests that white bass have become firmly established in Lewis and Clark Lake.

Green sunfish

This species was rarely collected in the reservoir. It was more abundant in the first 2 years after impoundment than in 1962 (table 2).

4/ Sprague, James W. 1960. Report of fisheries investigations during the fifth year of impoundment of Gavins Point Reservoir, 1959. Dingell-Johnson Project F-1-R-9, 47 pp. (Mimeo.)

Table 16:-- Age-class distribution and average total length at each annulus for 187 channel catfish, Lewis and Clark Lake, 1962

Age group	Year class	Age distribution (percent)	Average length (inches)
I	1961	2	4.3
II	1960	17	6.2
III	1959	6	8.1
IV	1958	4	9.8
V	1957	6	11.2
VI	1956	31	12.9
VII	1955	25	14.9
VIII	1954	7	17.6
IX	1953	2	19.9

Bluegill

The bluegill was a minor species in the reservoir (table 2). A relatively large year-class was produced in 1956 which dominated the population for at least 4 years (table 17). Reproduction after 1956 was apparently poor, and in 1962 only 10 fish were collected. Growth of this species was comparable to that reported from other areas of the United States (Carlander, 1953).

Orangespotted sunfish

This species was rare in Lewis and Clark Lake, and only one was collected during 7 years of sampling (table 2). Eight specimens were collected by other types of gear in 1962, but almost exclusively in protected inlets.

Hybrid sunfish

Six hybrid sunfish (probably bluegill-green sunfish) were identified from the fish collected in the reservoir.

Largemouth bass

The largemouth bass population in the reservoir was probably small, but relatively stable (table 2). This fish is difficult to collect with nets, and conclusions regarding its abundance must be viewed with caution. Shore seining indicated that a good year-class was produced in 1956 with some reproduction in all but two of the remaining years (table 7). One-hundred and fifty thousand fingerling bass were stocked in the reservoir in 1956 (table 1), but survival of these fish could not be ascertained since they were not marked and natural reproduction was known to occur (Shields, 1957, op. cit.).

All bass collected were mature by age IV and spawning was completed by July 1. Growth as determined from average lengths at each annulus was comparable to that for this species taken in other areas of the United States (Carlander, 1953). Available evidence indicates that the largemouth bass population in Lewis and Clark Lake will remain small.

White crappie

This species was one of the major fishes in the reservoir, and it was well distributed by area and depth. The white crappie is reportedly tolerant to a wide variety of habitats and especially toward turbidity and siltation. Catch of white crappie fluctuated widely between 1956 and 1962 (table 2). It was not very abundant in 1956 and

Table 17:-- Age-class distribution of bluegill in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of collection						
	1956	1957	1958	1959	1960	1961	1962
I	- -	84	16	3	- -	- -	- -
II	- -	15	78	3	- -	10	30
III	100	1	5	83	23	89	10
IV	- -	- -	1	11	75	1	30
V	- -	- -	- -	- -	2	- -	20
VI	- -	- -	- -	- -	- -	- -	10
Number of fish aged	12	46	112	70	35	41	10

1957, but more were collected in 1958 and 1959 than any other species. Abundance was reduced in 1960, and it remained relatively constant through 1962 (table 6). Number of white crappie was strongly influenced by the large 1956 year-class which dominated the population through 1962 (table 18). Reproduction from 1957 to 1962 was comparatively poor. The age-class distribution of the catch (table 18) suggests that fair reproduction occurred in 1957 and 1958, but this was not indicated by shore seining in those years (table 7). Results of shore seining suggest that reproduction in 1962 was the best since 1956.

Spawning and annulus formation for most fish was completed by July 1. Average length in inches by age group for fish collected in 1962 was as follows: I, 2.7; II, 4.0; III, 5.8; IV, 7.1; V, 8.2; VI, 9.6; VII, 10.6; and VIII, 12.2. Growth was poor compared to that attained by this species in other areas of the United States (Carlander, 1953), and much less than in Fort Randall Reservoir (Sprague, 1961, op. cit.), where lengths of 4-year-old fish were comparable to that of the 7-year-olds taken from Lewis and Clark Lake. Although growth was poor and reproduction erratic, the white crappie will probably continue to be one of the dominant fishes in the reservoir.

Black crappie

The black crappie is now a minor species in the reservoir, although it was important in 1957 and 1958 (table 2). A large year-class produced in 1956 dominated the catch for the following 2 years (table 19). Reproduction as indicated by shore seining was poor after 1956, and with the demise of this year-class the abundance of this species declined to a minor role (table 6). According to Harlan and Speaker (1951) and Trautman (1957), white crappie often is dominant over the black crappie in turbid waters, as is the condition in Lewis and Clark Lake.

Spawning and annulus formation were usually completed by July 1. Average length in inches by age group for fish collected in 1962 was as follows: I, 2.3; II, 4.5; III, 5.9; IV, 7.5; V, 9.0; and VI, 9.7. Like that of the white crappie, growth of the black crappie was poor compared with that in other areas of the United States (Carlander, 1953) and much poorer than in Fort Randall Reservoir (Sprague, 1961, op. cit.). All age groups of black crappie were found in the reservoir in 1962, suggesting limited successful spawning in each year. The decline in

Table 18:-- Age-class distribution of white crappie in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of Collection						
	1956	1957	1958	1959	1960	1961	1962
I	93	91	1	2	- -	- -	4
II	6	8	98	13	2	1	5
III	1	1	1	81	36	24	6
IV	- -	- -	- -	3	55	38	10
V	- -	- -	- -	1	6	34	22
VI	- -	- -	- -	- -	1	3	37
VII	- -	- -	- -	- -	- -	- -	14
VIII	- -	- -	- -	- -	- -	- -	2
Number of fish aged	180	136	148	161	139	145	330

Table 19:-- Age-class distribution of black crappie in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of collection						
	1956	1957	1958	1959	1960	1961	1962
I	61	98	- -	- -	- -	- -	2
II	38	1	100	2	12	5	15
III	1	1	- -	70	17	63	32
IV	- -	- -	- -	27	68	18	21
V	- -	- -	- -	1	2	4	26
VI	- -	- -	- -	- -	1	- -	4
Number of fish aged	82	147	144	156	77	49	47

abundance of this fish suggests that it will remain a minor species in this reservoir.

Yellow perch

Although fairly abundant in 1956, the year following dam closure, this fish was uncommon in the reservoir (table 2). Reproduction as determined by shore seining appeared good only in 1956, 1957, and 1958 (table 7). Fish collected after 1958 were all from the 1956-58 year-classes. Although fish up to 6 years old have been collected, almost none exceeded 6 inches in total length. According to Trautman (1957) perch are most abundant in clear waters of base or low gradient, and where there is an abundance of rooted aquatics. Numbers decrease drastically with increased turbidity and disappearance of rooted aquatics as is the condition in Lewis and Clark Lake.

Sauger

The sauger was the major sport species in Lewis and Clark Lake. This fish was resident in the Missouri River, and its abundance was increased since formation of the reservoir (table 2). This phenomenon also occurred after impoundment of Fort Randall Reservoir (Shields, 1957, op. cit.). A large sauger year-class was produced in Lewis and Clark Lake in 1956, and these fish dominated the catch until 1962 (table 20). Collections of young-of-the-year sauger taken by shore seine suggested little annual change in reproductive success (table 7). According to Shields (1957 op. cit.) seining is a poor indicator of juvenile sauger abundance. The age-class distribution of sauger collected since 1956 corroborate this view.

Sauger spawning was usually completed by May 15, and annulus formation generally occurred by the first week in June. Most fish were mature when they were 3 or 4 years old. Average length of sauger in inches by age group in 1962 was as follows:[5/] I, 5.5; II, 11.7; III, 14.7; IV, 18.9; V, 20.6; and VI, 21.2. Growth was similar to that found for sauger in Oahe (Fogle, 1961, op. cit.) and Fort Randall (Sprague, 1961, op. cit.) Reservoirs. Hassler (1957) reported that the average total length of 6-year-old sauger from Norris Reservoir to be 19.6 inches, which surpassed growth rates reported from other waters at that time. The sauger is well established in Lewis and Clark Lake and will probably continue as the dominant sport species.

Walleye

This species was uncommon in Lewis and Clark Lake. Almost a million walleye fry and fingerling were stocked in the reservoir in 1958 (table 1), but there was no evidence of survival of these fish. Nine (69 percent) of the thirteen walleyes collected in 1962 were 2 and 3 years old, and only one was 5 years old. Available evidence indicates that this species has not adapted to conditions found in the reservoir and that the population will probably remain small.

Freshwater drum

This species was well distributed throughout the reservoir, especially in the deeper portions. Relatively few drum were collected during the early years of impoundment, but in 1962 almost as many were taken as in the previous 6 years (table 2). Relative abundance of this species in 1962 increased markedly over previous years (table 6). Dominant year-classes were produced in 1956, 1957, and 1958 (table 21), but this was not evident from young fish collections obtained by shore seine (table 7).

Growth and annulus formation began about June 1, and spawning was generally completed by early July. Average length in inches by age group for fish collected in 1962 was as follows: I, 3.1; II, 5.8, III, 7.7; IV, 9.0; V, 10.0; and VI, 11.0. Growth was poor compared with that in Oahe (Fogle, 1961, op. cit.) and Fort Randall (Sprague, 1961, op. cit.) Reservoirs and with other areas of the United States (Carlander, 1953). The freshwater drum will probably remain one

5/-Vanicek, Charles David. 1963. Life history studies of the sauger, Stizostedian canadense (Smith), in Gavins Point Reservoir. M.S. Thesis, Iowa State University, Ames, Iowa, 56 pp.

Table 20:-- Age-class distribution of sauger in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of collection						
	1956	1957	1958	1959	1960	1961	1962
I	- -	77	18	1	- -	5	14
II	42	2	64	7	6	12	31
III	42	11	13	50	27	17	12
IV	16	8	2	30	62	23	14
V	- -	2	3	12	6	36	14
VI	- -	- -	- -	- -	- -	7	15
Number of fish aged	25	64	74	113	109	86	85

Table 21:--Age-class distribution of freshwater drum in percent of sample aged, Lewis and Clark Lake, 1956-62

Age group	Year of collection						
	1956	1957	1958	1959	1960	1961	1962
I	51	66	2	7	- -	- -	4
II	27	25	94	1[illegible]	10	12	14
III	18	6	2	76	45	14	6
IV	3	3	2	2	45	65	32
V	1	- -	- -	2	- -	7	34
VI	- -	- -	- -	- -	- -	2	8
VII	- -	- -	- -	- -	- -	- -	1
VIII	- -	- -	- -	- -	- -	- -	1
Number of fish aged	67	32	54	41	31	43	216

of the dominant species in the reservoir, but individuals will be slow growing and small.

CHANGES IN GROWTH

Comparison of the average length attained by fishes of the same age collected from 1956 to 1962 indicated that fish growth rate has decreased since impoundment. This is illustrated for carp, river carpsucker, white crappie, and sauger in figures 2 through 5. The sharpest growth change was evident for the carp, especially after the first year of life. There was a general but less severe decrease in growth for all ages of river carpsucker. Decrease in growth of white crappie was most evident for fish over 3 years of age. Sauger growth, except for age I fish, appeared least influenced by impoundment.

There was no apparent relation between changes in relative abundance and growth of river carpsucker and white crappie between 1956 and 1962. Abundance of river carpsucker remained relatively unchanged (table 6) while its growth rate decreased (fig. 3). Abundance of white crappie first increased and then decreased (table 6) while its growth rate decreased (fig. 4). Both relative abundance and growth rate of carp decreased sharply from 1956 to 1962 (table 6; fig. 2). Relative abundance of sauger (table 6) increased while its growth rate declined (fig. 5) over these years. The significance of these relationships is unknown at present. Decrease in fish growth since impoundment was probably caused by a change in the aquatic environment independent of the relative abundance of the individual fish species.

DISCUSSION

Studies in Lewis and Clark Lake from 1956 to 1962 indicated that the reservoir was dominated by carp, river carpsucker, and white crappie, with relatively few game and pan fishes. Relative fish abundance, as determined by experimental gill net and frame net catches, generally decreased after 1957, with a greater proportionate decrease in sport fish than rough fish numbers. Fish reproduction and growth were generally good for all species during the first year of impoundment, but were poor for most

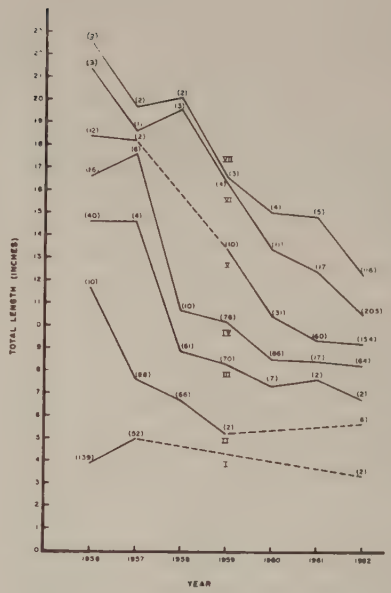

Figure 2:--Growth history of carp in Lewis and Clark Lake during the first 7 years of impoundment. Solid lines connect points representing average lengths of age groups (Roman numerals) at time of capture (June-August). Number of fish aged in parenthesis.

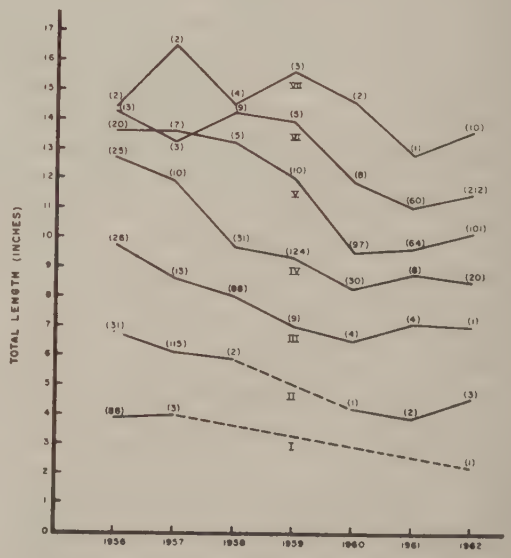

Figure 3:--Growth history of river carpsucker in Lewis and Clark Lake during the first 7 years of impoundment. Solid lines connect points representing average lengths of age groups (Roman numerals) at time of capture (June-August). Number of fish aged in parenthesis.

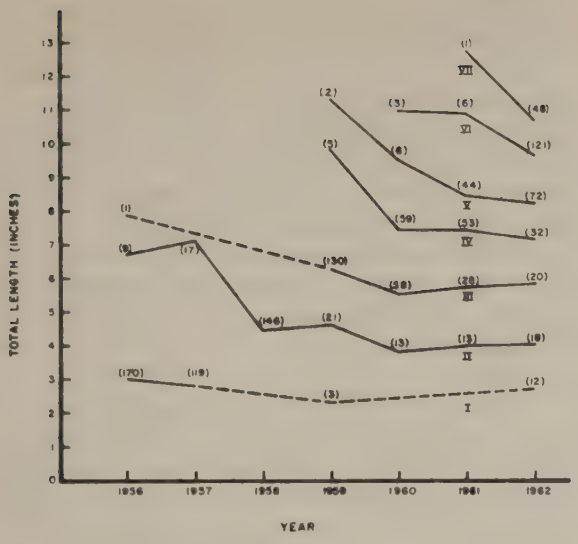

Figure 4:--Growth history of white crappie in Lewis and Clark Lake during the first 7 years of impoundment. Solid lines connect points representing average lengths of age groups (Roman numerals) at time of capture (June-August) Number of fish aged in parenthesis.

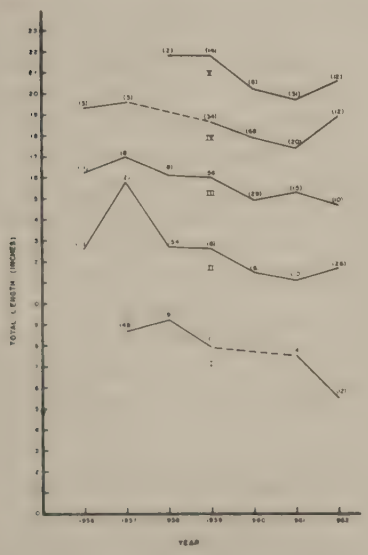

Figure 5:--Growth history of sauger in Lewis and Clark Lake during the first 7 years of impoundment. Solid lines connect points representing average lengths of age groups (Roman numerals) at time of capture (June-August) Number of fish aged in parenthesis.

species during the remainder of the period. Reasons for poor reproduction and growth after 1957 are unknown, but they may be related to the rapid exchange of water, increased turbidity, or to the pattern of reservoir water level fluctuation as suggested by Shields 6/.

Lewis and Clark Lake is a re-regulating type reservoir and water levels can be expected to fluctuate from 1 to 2 feet each week, April through November. Seasonal water level fluctuation, primarily for flood control, requires that the reservoir be maintained at the maximum level (1,208 feet) until April and then drawn down to the minimum level (1,204 feet) until the end of of July. In 1956 the water level in the reservoir reached planned operational stage (1,205 feet) in February. During the latter part of March there was a drawdown of 15 feet to allow completion of certain construction phases of the project. By the end of June construction was completed, and between June 15 and July 1 the reservoir was restored to normal operating pool (1,204 feet).

The pattern of water level fluctuation which occurred in 1956, the year in which reproduction and growth were good for most fishes, has not been duplicated. This suggests that rising water levels during the month of June may be beneficial for reproduction of most species. Shields 6/ suggested that the production of fish food organisms and hence fish growth could be increased by maintaining the water level at minimum pool (1,204 feet) until about mid-June and then raising the level to maximum pool (1,208 feet) until September. This might encourage terrestrial vegetation in the shallow flood plain and possibly increase growth of rooted aquatics beneficial for production of aquatic organisms.

Another factor related to water level fluctuation which may effect reproduction and growth is surface wind. High wind combined with low water levels increases the effect of wave action in littoral areas and increases turbidity. Wave

6/Shields, James T. 1958. Report of fisheries investigations during the third year of impoundment of Gavins Point Reservoir, South Dakota, 1957. Dingell-Johnson Project F-1-R-7, 48 pp. (Mimeo.)

action over littoral areas influences year-class survival of nest-building species by mechanical destruction of nests (Kramer and Smith, 1962). Increased turbidity decreases production of plankton necessary for fish food and fish growth (Buck, 1956). The poor growth found for many fishes in Lewis and Clark Lake compared to growth attained by these same species in Fort Randall and Oahe Reservoirs may be related to differences in water depth and turbidity. The waters of both Oahe and Fort Randall Reservoirs are relatively deep and clear and therefore less influenced by surface winds, while Lewis and Clark Lake is shallow and turbid.

The fish population of Lewis and Clark Lake did not appear to attain stability during the period of study. Most species produced a large year-class in 1956 and this group more or less dominated the adult population complex through 1962. The population produced with the present schedule of reservoir water management will probably be dominated by river carpsucker, carp, and freshwater drum. The predominant sport fishes will probably be white crappie, sauger, channel catfish, and perhaps white bass. Future abundance of individual species will be dependent on spawning success and survival which may be influenced by alterations in the pattern of water level fluctuation,

SUMMARY

The fish population of Lewis and Clark Lake has been studied since 1956, following closure of Gavins Point Dam on July 31, 1955. Investigations were conducted by the South Dakota Department of Game, Fish, and Parks from 1956 to 1961 and continued by the Bureau of Sport Fisheries and Wildlife in 1962. The purpose of these studies was to monitor the development of the fish population so that practical management measures could be formulated. This report summarizes the results of these investigations.

The reservoir has a maximum surface area of 33,000 acres, is 37 miles long and averages 2 miles wide. Its depth ranges from 45 feet near the dam to less than 6 feet in its upper extremity. Total shoreline is 100 miles, and storage capacity is 540,000 acre-feet. Lake level is maintained between 1,204 and 1,208 feet m.s.l. under normal operational conditions. The reservoir is characterized by rapid exchange of water, and during spring and summer the entire storage is passed through the dam every 8 to 10 days. During the winter, complete exchange is possible every 30 days. Dissolved oxygen, water temperature, alkalinity, and pH were satisfactory for warm-water fishes. Secchi-disk visibility ranged from 3 inches in the extreme upper reservoir to 3 feet near the dam.

Fish were collected by gill nets, frame nets, and shore seines. Scale samples, total length, weight, sex, and maturity were obtained for fish collected at each station by each sampling method. Collections by shore seine were preserved and returned to the laboratory for further study. Methods of investigation used by personnel of the South Dakota Department of Game, Fish, and Parks and the Bureau of Sport Fisheries and Wildlife were similar.

Numbers of fish collected by gill and frame nets in June, July, and August, 1956 through 1962, were used to determine trends in relative abundance of those fish vulnerable to capture by these gear. Thirty-three species, exclusive of minnows were collected during these years. Most abundant fishes were carp, river carpsucker, and white crappie. Other major species, not in order of abundance, were shovelnose sturgeon, shortnose gar, smallmouth buffalo, channel catfish, black crappie, sauger, and freshwater drum. The following species disappeared or were rare following impoundment: pallid sturgeon, paddlefish, longnose gar, rainbow trout, blue sucker, blue catfish, stonecat, black bullhead, northern pike, burbot, green sunfish, and orangespotted sunfish.

Relative annual abundance of major species was determined by comparison of the average catch per unit of effort of each type fishing gear. Apparent abundance of most fishes declined between 1956 and 1962. Marked decreases were suggested for shovelnose sturgeon, carp, and black crappie. White and black crappie experienced wide fluctuations in abundance, and in 1962 both were at a low level with white crappie predominating.

Abundance of shortnose gar, smallmouth buffalo, and river carpsucker remained rather stable after 1957, while abundance of sauger and drum increased. The silvery minnow, which was very abundant following impoundment, was replaced by the emerald shiner as the dominant cyprinid. Young-of-the-year gizzard shad was the most abundant forage species. Survival of juvenile gizzard shad to their second summer was apparently related to the number of days of reservoir ice cover during the previous winter.

Life-history observations were conducted on the fishes collected to determine (1) age and rate of growth, (2) age-class composition, (3) habitat preference, (4) period of spawning, and (5) reproductive success. Fish reproduction and growth were generally good for all species during the first year of impoundment, but poor for most species after that time. Specific reasons for reduced reproductive success and growth are unknown, but they may be related to the pattern of water level fluctuation.

Except for white bass, fish stocking in Lewis and Clark Lake was apparently ineffectual.

The reservoir fish population did not appear to attain stability during the period of study. The population produced with the present schedule of water management will probably be dominated by river carpsucker, carp, freshwater drum, white crappie, sauger, channel catfish, and white bass.

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APPENDIX B--Scientific and common names of fishes collected from Lewis and Clark Lake, 1956-62.

ACIPENSERIDAE--sturgeons:
Scaphirhynchus albus, pallid sturgeon
Scaphirhynchus platorynchus, shovelnose sturgeo

POLYODONTIDAE--paddlefishes:
Polyodon spathula, paddlefish

LEPISOSTEIDAE--gars:
Lepisosteus osseus, longnose gar
Lepisosteus platostomus, shortnose gar

CLUPEIDAE--herrings:
Dorosoma cepedianum, gizzard shad

SALMONIDAE--trouts:
Salmo gairdneri, rainbow trout

HIODONTIDAE--mooneyes:
Hiodon alosoides, goldeye

ESOCIDAE--pikes:
Esox lucius, northern pike

CYPRINIDAE--minnows and carps:
Cyprinus carpio, carp
Hybognathus nuchalis, silvery minnow
Hybopsis gracilis, flathead chub
Hybopsis storeriana, silver chub
Notropis atherinoides, emerald shiner
Notropis lutrensis, red shiner
Notropis stramineus, sand shiner
Pimephales promelas, fathead minnow

CATOSTOMIDAE--suckers:
Carpiodes carpio, river carpsucker
Catostomus commersoni, white sucker
Cycleptus elongatus, blue sucker
Ictiobus bubalus, smallmouth buffalo
Ictiobus cyprinellus, bigmouth buffalo
Moxostoma macrolepidotum, northern redhorse

ICTALURIDAE--freshwater catfishes:
Ictalurus furcatus, blue catfish
Ictalurus melas, black bullhead
Ictalurus punctatus, channel catfish
Noturus flavus, stonecat
Pylodictis olivaris, flathead catfish

GADIDAE--codfishes:
Lota lota, burbot

SERRANIDAE--sea basses:
Roccus chrysops, white bass

CENTRARCHIDAE--sunfishes:
Lepomis cyanellus, green sunfish
Lepomis humilis, orangespotted sunfish
Lepomis macrochirus, bluegill
Micropterus salmoides, largemouth bass
Pomoxis annularis, white crappie
Pomoxis nigromaculatus, black crappie

PERCIDAE--perches:
Perca flavescens, yellow perch
Stizostedion canadense, sauger
Stizostedion v. vitreum, walleye

SCIAENIDAE--drums:
Aplodinotus grunniens, freshwater drum

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